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A NEW SPECIES OF *ISCHNOCHITON* (MOLLUSCA: POLYPLACOPHORA: ISCHNOCHITONIDAE) FROM SOUTH AUSTRALIA, WITH A DISCUSSION OF THE STATUS OF *ISCHNOCHITON LEVIS*, TORR, 1912

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Abstract: A new species of chiton, *Ischnochiton crebristriatus* sp. nov., is described from South Australia. Specimens belonging to this species were previously identified as *Ischnochiton levis* Torr, 1912. However, the holotype of *I. levis* is a specimen of another species, *I. wilsoni* Sykes, 1896; all of the other specimens attributed to *I. levis* are now considered to belong to a previously-undescribed species which has a sympatric distribution with *I. wilsoni* in South Australia. Hence, *I. levis* is synonymized with *I. wilsoni*, and a new name, *I. crebristriatus* is proposed for the other specimens previously identified as *I. levis*. The new species has been collected in coastal waters from Nuyts Archipelago to Port Willunga, South Australia, to depths of 15 metres, on rocks embedded in sand.

While examining specimens identified as *Ischnochiton levis* Torr, 1912, from the collections of the South Australian Museum, Adelaide (SAM), a discrepancy was found between the holotype (SAM D11976), and other specimens which were identified as this species. The holotype of *I. levis* is conspecific with *I. wilsoni*, while the other specimens attributed to *I. levis* are recognized as a previously-undescribed species, which has a sympatric distribution with *I. wilsoni* in South Australia. In this paper, the new species is described and compared with morphologically-similar species, and the status of *I. levis* is discussed.

MATERIALS AND METHODS

The type specimens, and all other specimens of the new species examined by the author, are deposited in the South Australian Museum. Other comparative material from the following museums was also examined: the Academy of Natural Sciences, Philadelphia (ANSP); the Australian Museum, Sydney (AM); the Museum of Victoria (MV); and the South Australian Museum. Registration numbers and measurements for all material used in the study are on file in the Department of Invertebrate Zoology, Museum of Victoria.

Measurements of body dimensions and the macroscopic structure of the valves were made with vernier calipers. Meristic structures were counted and measurements of microscopic structures (e.g., girdle scales) were obtained under a dissecting microscope in which a graticule micrometer had been inserted into the eyepiece. Selected morphometric measurements of the new species, and of the comparative material, were analysed with one-way Analyses of Variance (ANOVA). Data obtained from ratios of measurements were only used if they were normally distributed. Means and Bonferroni confidence intervals (which are based on the Bonferroni probability inequality) (Lee *et al.* 1984) were calculated from those data which showed a significant ANOVA result.

The radula and a portion of the girdle were removed from one of the paratypes (SAM D16571), and prepared for examination under a scanning electron microscope (SEM). The tissues were cleaned in an ultrasonic cleaner, dehydrated in an alcohol series (70%-100% ethanol) and dried in a critical-point dryer. A Sputter Coater was used to coat the samples with gold. Terminology for valve morphology is based on Kaas and Van Belle (1985).

Ischnochiton crebristriatus sp. nov.
Figs 1-4; Tables 1, 2

Ischnochiton (*Euporoplax*) *levis* (*non I. levis* Torr 1912): Cotton & Weeding 1939: 184, 193, 198; Cotton & Godfrey 1940: 507-8; Cotton 1964: 148-9.

Diagnosis: Slope of anterior valve straight or slightly concave; girdle scales very small (60-160 μm wide), glossy, containing a large number of striae (up to 20) for the genus. Sculpture very weak, apophyses wide and flattened.

Materials Examined: *Holotype*: SAM D18405, dried, complete specimen, 16.68 × 8.74 mm, collected inside reef, on the SW side of East Franklin Island (Loc. H), Franklin Islands, Nuyts Archipelago, South Australia (32° 27′ S, 133° 40′ E), on rocks and pebbles under sand in 8 metres of water, by K. Gowlett 13.iv.1983.

Paratypes: Four dried, complete specimens, same collection data as holotype (SAM D16572); one partially-disarticulated specimen, preserved in 2% formaldehyde/propylene glycol solution in sea water, same locality as holotype, collected on rock under sand at depths of 6-8 m, by P. Aerfeldt 13.iv.1983 (SAM D16571); two dried, complete specimens, collected between West Franklin Island and Seal Island, Franklin Islands, Nuyts Archipelago, South Australia, on smooth granite and pebbles under sand, 6-11 m of

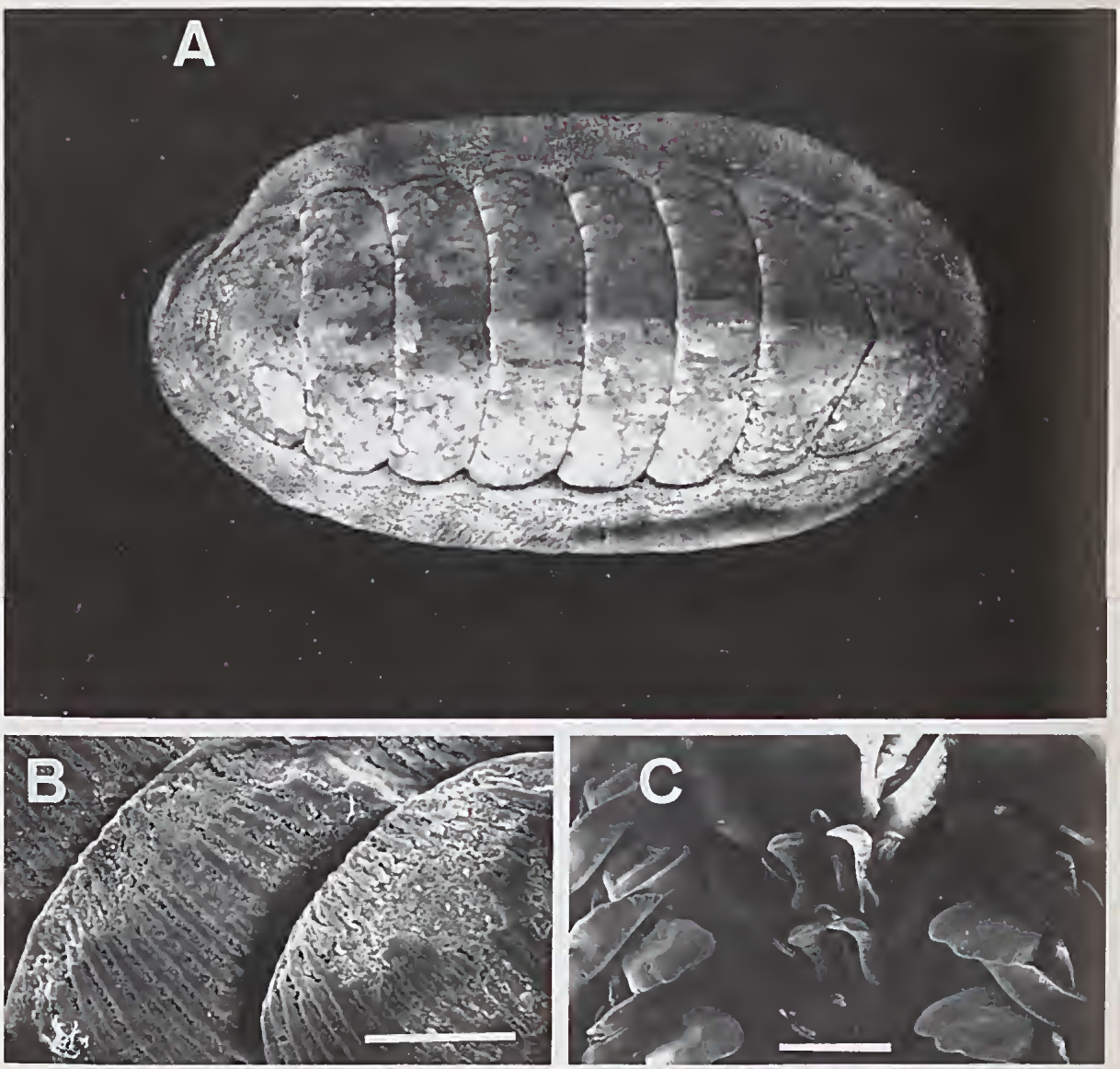

Fig. 1—*Ischnochiton crebristriatus* sp. nov. A, Holotype, SAM D18405 (×6.6 mag). B, Girdle scales, Paratype SAM D16571 (Scale bar = 40 μm). C, Radula, Paratype SAM D16571 (Scale bar = 100 μm).

water, by K. Gowlett 25.ii.1983 (SAM D16570); one dried, partially-disarticulated specimen, collected in a cove, on the NW point of East Franklin Island, Franklin Islands, Nuyts Archipelago, South Australia, on edge of granite slope under sand, in 8 m of water, by K. L. Gowlett 20.vii.1983 (SAM D16573); one dried, complete specimen, North Islands, Franklin Islands, Nuyts Archipelago, South Australia, collected on rock under sand in 15 m water, by K. Gowlett 24.ii.1983 (SAM D16569); two dried, complete specimens, W end of Seal Island, Franklin Islands, Nuyts Archipelago, South Australia, collected on granite rock under sand in 6 m water, by K. Gowlett 17.vii.1983 (SAM D16574); three dried, complete specimens, North Islands, Franklin Islands, Nuyts Archipelago, South Australia, collected on granite rock under medium-coarse sand in 10 m water, by K. Gowlett 21.vii.1983 (SAM D16568); one dried, complete specimen, collected at Arno Bay, South Australia, by B. J. Weeding (SAM D14482); one dried, complete specimen, collected at Moonta Bay, near Port Hughes, South Australia, by B. J. Weeding i. 1932 (SAM D18406); one dried, broken specimen, collected at Port Willunga, South Australia, by E. Ashby (SAM D11774).

DESCRIPTION: *General*: Specimens to 21 mm long (mean ± sd = 12.33 ± 3.25 mm), oval to elongately oval (Fig. 1A), with an average total length: total width ratio of 1.77:1 (Fig. 4A); carinated with convex sides (Fig. 2E) and moderate elevation (average height:width ratio of valve V = 0.37) (Fig. 4B). Colour of tegmentum typically fawn or white, mottled with pale green,

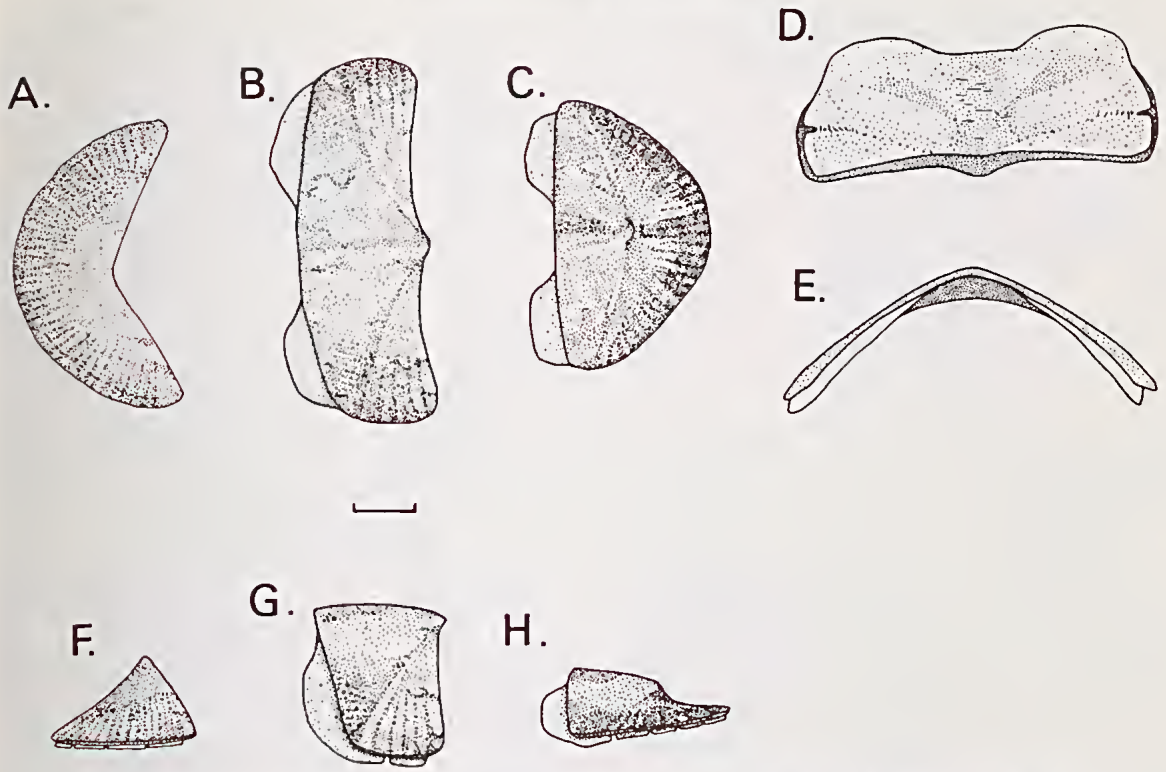

Fig. 2—*Ischnochiton crebristriatus* sp. nov. A, Dorsal view of anterior valve. B, Dorsal view of intermediate valve (V). C, Dorsal view of posterior valve. D, Ventral view of valve V. E, Anterior profile of valve V. F, Lateral view of anterior valve. G, Lateral view of valve V. H, Lateral view of posterior valve. (Figs A-E, G, H, Paratype SAM D16573; Fig. F, Paratype SAM D16571). Scale bar = 1 mm.

rose pink, orange, grey and brown. However, the colours may form solid areas on some specimens, usually in shades of pink, orange and white. Entire surface of tegmentum granulated with minute, very-weak pustules (approximately 40 μm in diameter); weak radial-ribbing present on anterior valve, lateral areas of intermediate valves, and on postmucronal area of posterior valve. Colour of girdle white or fawn, with pink or mushroom bands, which are occasionally interspersed with dark brown scales. *Anterior valve*: sculptured with 25-50 very-weak, radial ribs which extend approximately half way up the valve from its base (Fig. 2A). Valve semi-circular; posterior margin widely v-shaped; anterior slope straight to slightly concave (Fig. 2F). The concavity of the valve is more noticeable in adult specimens. *Intermediate valves*: beaked; length approximately ⅓ of width of valve (average length:width ratio of valve V = 0.34, n = 17, Figs 2B, 4D); lateral areas slightly raised, with 4-7 weak ribs; granules of underlying sculpture coalesced in pleural areas to form 14-30 weak, horizontal to diagonal, ridges which extend from the anterior edge to the lateral area of each valve (Figs 1A, 2B, G). *Posterior valve*: rounded; slightly more than 1½ times wider than long (Figs 2C, 4E); anterior margin straight; mucro rounded, elevated, and slightly posterior to central (Figs 2H, 4F); antemucronal area sculptured in the same way as central area of intermediate valves; diagonal line of valve convexly v-shaped; postmucronal slope of valve concave, and sculptured with 20-38 very-weak, radial ribs which extend approximately ½-⅔ distance to the mucro (Fig. 2C). *Articulamentum*: white, tinted with mushroom brown, mauve or rose pink; apophyses and insertion teeth white; apophyses of median valves flattened, wide, and extend about ¾ of the height of the valve (Fig. 2G); jugal sinus narrow, about ¼ of width of valve (Figs 2B, D, 4C). Slit formula: 9-13/1/9-11. *Girdle*: narrow, about 1/10 of width of specimen (average width girdle:specimen ± sd = 0.13 ± 0.02, n = 17), and covered with imbricating, rounded, striated, calcareous scales (Fig. 1B); scales glossy, convex, and very small, being 120-160 μm wide adjacent to the valves (average width ± sd = 136 ± 9μm, n = 17); striated with 14-20 very fine ridges (Figs 1B, 4G, H), gradually becoming smaller (60-110 μm, $\bar{x} \pm sd = 76 \pm 14\mu m$, n = 17) with fewer striae (9-13) towards the edge of girdle. *Gills*: holobranchial; adanal with interspace, extending from posterior edge of valve II to approximately ½ length valve VIII; 24-27 ctenidia on each side of body; gonopore located between ctenidia 7 & 8, while nephridiopore situated one ctenidium behind the gonopore (between ctenidia 6 & 7). *Radula*: Central and first lateral teeth elongate and narrow; major

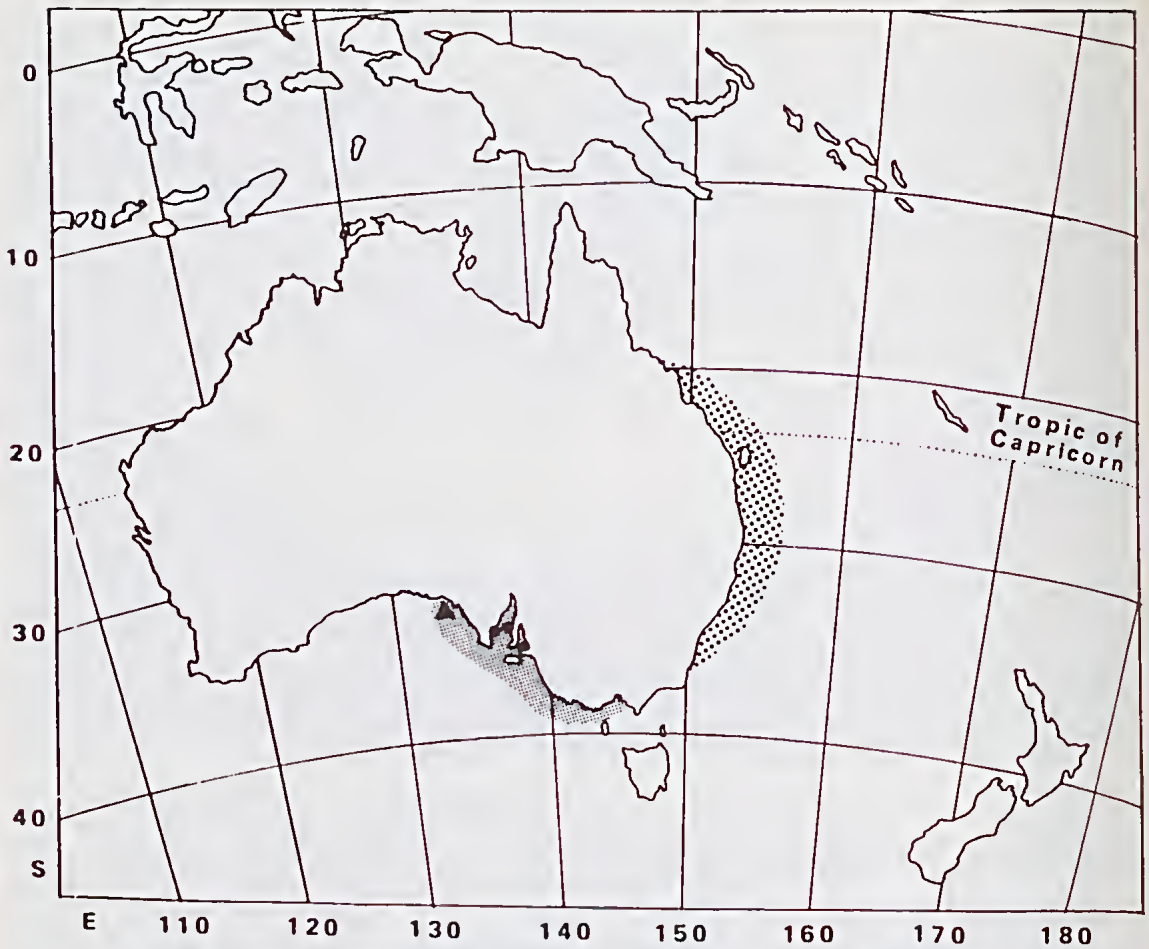

Fig. 3—Distribution of *Ischnochiton wilsoni* (fine stippling), *I. examinandus* (coarse stippling), and *I. crebristriatus* sp. nov. (solid symbols). Solid triangle—Type locality of *I. crebristriatus*; solid dots—distribution records for *I. crebristriatus*.

lateral teeth with strong, bidentate cusps, both denticles of approximately equal size; spatulate unicinal teeth long and pointed, with a broad groove on the outer surface, inwardly curved to lie against major lateral teeth (Fig. 1C).

Distribution and Habitat: The known range of this species extends from the Nuyts Archipelago (32° 27′ S, 133° 40′ E) to Port Willunga (35° 16′ S, 138° 27′ E), South Australia (Fig. 3). The new species has been found on rocks embedded in sand, usually in sand pockets (K. Gowlett-Holmes pers. comm.) to depths of 15 m, although specimens have occasionally been collected under rocks either intertidally or in shallow water. The type of habitat in which the new species is found, is one which is rarely sampled for chitons by collectors. Hence, the restricted distribution of this species probably reflects a deficiency in collecting within suitable habitats in other areas, rather than the actual range of the species.

Etymology: The specific name, *crebristriatus* (L. *creber*: crowded together, numerous; L. *stria*: grooves, furrows), refers to the large number of fine striae on the girdle scales, which is one of the most distinguishing features of this species.

Comparison with other species: *Ischnochiton crebristriatus* may be distinguished from other species of *Ischnochiton* by its very-small, glossy, girdle scales which are covered by an unusually large number of striae for their size. The tendency towards concavity in the slope of the anterior valve in adult specimens is also an unusual feature, being previously recorded for only one other species, *Stenochiton pilsbryanus* (Bednall 1897). *I. crebristriatus* most closely resembles *I. wilsoni* Sykes, 1896 and *I. examinandus* Hull, 1923. However, morphometric and meristic comparisons between these three species show several differences (Tables 1 & 2, Fig. 4). *I. crebristriatus* may be distinguished from *I. wilsoni* by its more ovate outline (Fig. 4A), smaller size, higher average dorsal elevation (Fig. 4B), and smaller girdle scales containing many more striae (Figs 4G, H), which are seen as very fine ridges. The striae on the girdle scales of *I. wilsoni* are coarser

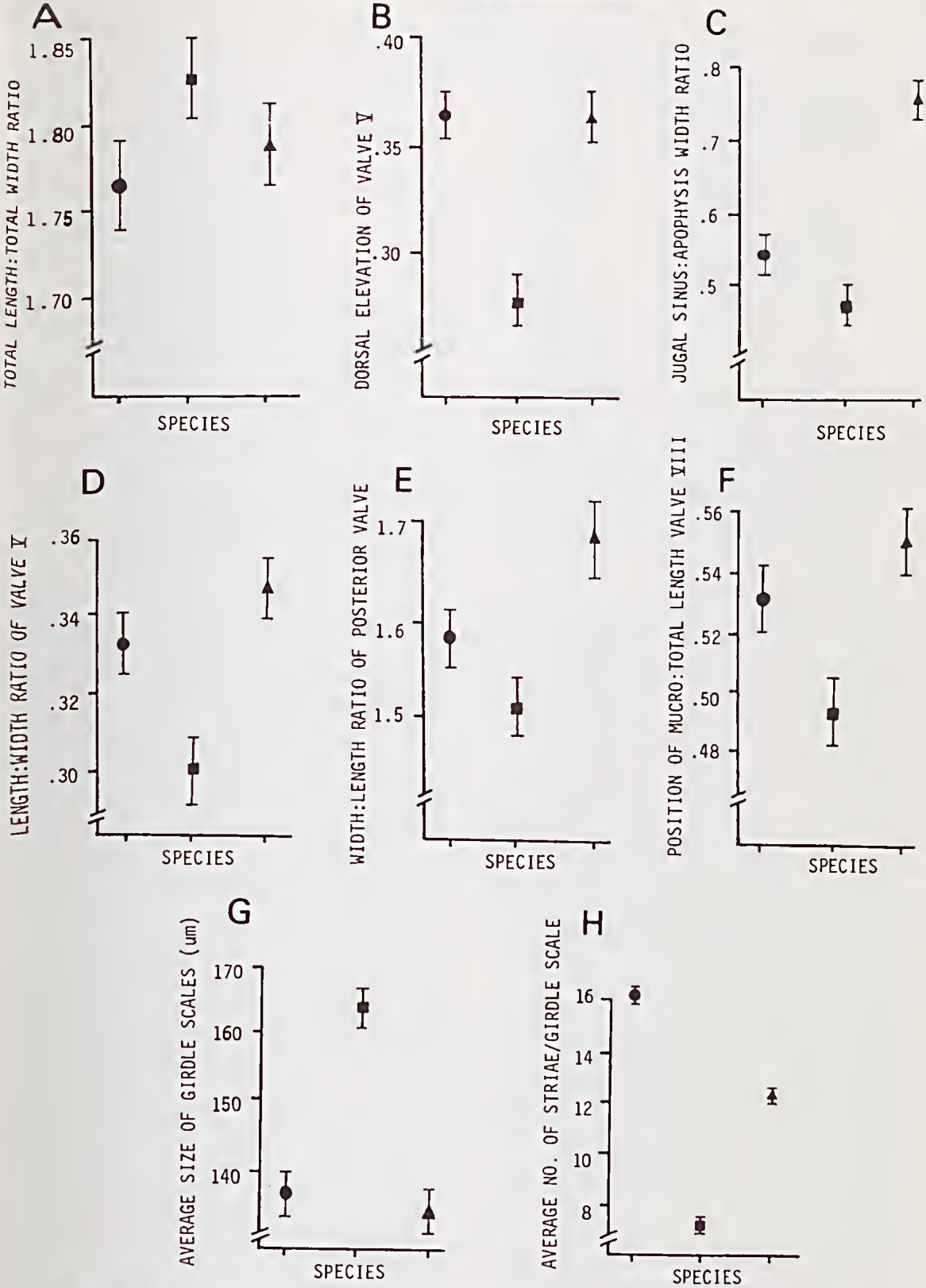

Fig. 4—Comparisons between different morphological characters for *I. crebristriatus* (solid circles), *I. wilsoni* (solid squares), and *I. examinandus* (solid triangles). Values indicate mean Bonferroni confidence intervals obtained from results of one-way ANOVA's (see Table 2).

TABLE 1
COMPARISON OF SELECTED CHARACTERS OF *Ischnochiton crebristriatus* SP. NOV., *I. wilsoni* AND *I. examinandus*.

Character	*I. crebristriatus*	*I. wilsoni*	*I. examinandus*
Body length	to 21 mm	to 34 mm	to 18 mm
Slope of anterior valve	straight-slightly concave	slightly convex	convex
Morphology of posterior edge of intermediate valves	straight	straight	finely serrated
Number of ribs on valves Range (Mean ± S.D.)			
Anterior	25-50 (38 ± 1)	0	24-52 (39 ± 6)
Intermediate	4-7 (5 ± 1)	0	4-7 (5 ± 1)
Posterior	20-38 (31 ± 5)	38-67 (52 ± 7)	16-42 (31 ± 7)
Granules underlying sculpture	very weak, 40-60 μm diameter	very weak, 40-60 μm diameter	stronger, 80-100 μm diameter
Shape of apophyses	flattened	flattened	rounded
Number of ctenidia each side of body	24-27	28-36	18-24
Typical position of gonopore	between ctenidia 7&8	between ctenidia 10&11	between ctenidia 6&7
Typical position of nephridiopore	between ctenidia 6&7	between ctenidia 8&9	between ctenidia 5&6
Typical coloration	mottled pink, fawn green & grey	pink with longitudinal grey streaks	mottled/blotched pink or fawn with green, grey blotches

and more strongly developed than those of *I. crebristriatus*; the colour patterns of the tegmentum and girdle of the two species also differ (Table 1). Radial ribs are present on all valves of *I. crebristriatus*; ribbing of the tegmentum is confined to the posterior valve of *I. wilsoni* (Table 1). The intermediate valves and the jugal sinus of *I. crebristriatus* are proportionately wider than those of *I. wilsoni* (Figs 4C, D). The posterior valve of *I. crebristriatus* is also relatively broader and the mucro is situated more posteriorly than that of *I. wilsoni* (Figs 4E, F). In addition, *I. crebristriatus* has fewer ctenidia than does *I. wilsoni*, and the nephridiopore is situated between ctenidia 6 & 7, one ctenidium behind the gonopore; in *I. wilsoni*, the nephridiopore is situated two ctenidia behind the gonopore, between ctenidia 8 & 9.

I. crebristriatus can be separated from *I. examinandus* by the finer granulose sculpture of the tegmentum, the absence of serrations along the posterior margin of the intermediate valves, a narrower jugal sinus (Fig. 4C) and flattened apophyses. The posterior valve of *I. crebristriatus* is more elongate than *I. examinandus* (Fig. 4E), and there is a tendency towards a smaller ratio of length:width of the intermediate valves and a more centrally-positioned mucro in *I. crebristriatus* (Figs 4D & 4F respectively). Although the girdle scales of *I. crebristriatus* are approximately the same size as those of *I. examinandus*, they contain more striae (Figs 4G, H). *I. examinandus* has relatively fewer ctenidia than *I. crebristriatus*, and the gonopore is situated one ctenidium behind the position of the gonopore in *I. crebristriatus* (i.e. between ctenidia 6 & 7 rather than 7 & 8). The geographic range of *I. examinandus* extends from New South Wales to Queensland (Iredale & Hull 1927), while *I. crebristriatus* has only been found in South Australia (Fig. 3).

DISCUSSION OF THE STATUS OF *Ischnochiton levis*: *I. levis* has been regarded as a synonym of *I. wilsoni* by some authors (Gatliff & Gabriel 1917, Ashby 1918, 1926, Iredale & Hull 1924, 1927) and as a valid species by others (Cotton & Weeding 1939, Cotton & Godfrey 1940, Cotton 1964, Kaas & Van Belle 1980, Zeidler & Gowlett 1986). The differences of opinion in the literature have probably resulted from the inclusion of specimens of the new species and *I. wilsoni* with *I. levis*.

In the original description of *I. levis*, Torr (1912) made a comparison between *I. levis* and *I. wilsoni* in which he regarded tegmental sculpture as the main feature which separated the two species. However, Gatliff & Gabriel (1917) synonymized *I. levis* with *I. wilsoni*, after examining the holotype of *I. levis*, stating that Torr requested them to record their findings that *I. levis and I. wilsoni* were conspecific.

In their recognition of *I. levis* as a valid species, Cotton and his co-authors (Cotton & Weeding 1939, Cotton & Godfrey 1940, Cotton 1964) used the morphology of the girdle as the diagnostic character of *I. levis*. These authors were using the SAM collections as a basis for their work. Hence, specimens of the new species were probably used by them in defining *I. levis* as a valid species, as in the present study, the most obvious differences between *I. wilsoni* and the new species were found to relate to the morphology of the girdle scales. Cotton & Weeding (1939) considered that